

RE 10-27-JAH
BELLCOMM, INC.

SUBJECT: Data Generated by Experiments
on AAP Flights 1A through 4
Case 600-2

DATE: September 22, 1967
FROM: R. K. Agarwal

ABSTRACT

This memorandum contains estimates of the data generated on the first five flights of the Apollo Applications Program. Details such as the duration of inflight data collection, number and type of channels, sampling rates, and the total amount of data collected are given for each experiment in Appendix A. Since the experiment definitions and flight assignments are continually changing, the data in this memorandum must be used with caution. They are intended to be used for general planning purposes and not as design requirements.

The changes between Case I (March) and Case II (July) 1967 in experiment assignments and in the experiment definitions have led to noticeable, but not significant, reductions in estimates of both data rates and total data, as shown below:

	Case I			Case II
	<u>Data Rate</u> (bits/sec)	<u>Total Data</u> (bits)	<u>Data Rate</u> (bits/sec)	<u>Total Data</u> (bits)
AAP 1A	-----	-----	3K	4×10^8
AAP 1-2	25K	7×10^9	18K	2×10^9
AAP 3-4	24K	1×10^{10}	19K	6×10^9

The above data rates are the sum of the data rates coming from each experiment. The sampling rate used for each experiment is that specified by the principal investigator; where only a bandwidth was specified, the Nyquist rate (twice the bandwidth) is used. The above data totals represent only the "desired" bits from each experiment, i.e., the bits that are collected if the duration of the experiment and the rates at which the experiment sensors are sampled are exactly as requested by the principal investigator.

If the sampling rates used for each experiment are adjusted to be at least four times the signal bandwidth, and if they are further adjusted to the sampling rates available on the PCM system of the experiment's carrier module, then the data rates would be more than doubled, as illustrated below.

(NASA-CR-90671) DATA GENERATED BY
EXPERIMENTS ON AAP FLIGHTS 1A THROUGH 4
(Bellcomm, Inc.) 35 p

N79-73001

Unclassified
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	Case II <u>Data Rate</u> (bits/sec)	Case II (With Adjusted <u>Data Rate</u> Sampling Rates) (bits/sec)
AAP 1A	3K	11K
AAP 1-2	18K	47K
AAP 3-4	19K	40K

It is also significant to note the impact of the EKG measurements on the data rates. This is illustrated by the following tabulation:

	<u>Case II With Adjusted Sampling Rates</u>	
	<u>Data Rate With EKG's</u>	<u>Data Rate Without EKG's</u>
AAP 1A	11K	11K
AAP 1-2	47K	16K
AAP 3-4	40K	11K

The rates shown in the left-hand column assume experiment EKG measurements would be sampled and digitized. If these measurements were instead recorded and transmitted as analog signals, the bit rates would drop to less than one-third of their value, as shown in the right-hand column. Thus, if PCM channel availability is limited, analog data handling, data compression, and a hard look at requirements should be considered for EKG data.

BELLCOMM, INC.

1100 Seventeenth Street, N.W. Washington, D.C. 20036

SUBJECT: Data Generated by Experiments
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Case 600-2**DATE:** September 22, 1967
FROM: R. K. AgarwalMEMORANDUM FOR FILEINTRODUCTION

The Apollo Applications Program is a series of missions with the primary purpose of performing experiments in space. Both the set of experiments and their flight assignments are still changing, even for the earliest missions. Nevertheless, it is important to get some idea of the data loads expected from these experiments and to study them on a mission-by-mission basis. These data loads are needed to specify the requirements for on-board and ground data processing systems. They also are needed as feedback to the assignment of experiments to missions.

A previous attempt at estimating the data loads for AAP was presented in a memorandum by P. S. Schaenman, dated May 31, 1966.* The present memorandum represents current estimates for the first five AAP flights (1A, 1, 2, 3 and 4). These five flights include 55 experiments out of approximately 150 experiments tentatively assigned to all AAP missions. A summary of data estimates issued by the author as working papers on March 23, 1967, referred herein as Case I, is also included to give an idea of how the changing of experiment payloads affects overall data rates and amounts of data. Comments received from the Manned Spacecraft Center (MSC) and Marshall Space Flight Center (MSFC) on the working papers have been incorporated.

TYPES OF ESTIMATES PROVIDED

Estimates of experiment data are presented in three sets of charts in this report. One set, the Experiment Data Estimate Charts, is given in Appendix A and contains for each experiment detailed information such as data collection periods, sampling rates, total bits, etc. This information is based on experiment considerations alone whenever possible.

*"Data Generated by AAP Experiments," Memorandum for File, Case 218, P. S. Schaenman, May 31, 1966.

That is, a sampling rate may be given as the minimum rate required by the experiment, rather than the "best fit" chosen from the sampling rates available on the experiment's carrier module. If a sampling rate has been specified by a Principal Investigator (P.I.), it is used; if not, the Nyquist rate (twice the information bandwidth) is used. The experiment charts, therefore, provide a means for determining what is theoretically required by an ensemble of experiments as opposed to what is eventually allocated for them. These charts should be relatively unaffected by shifts of experiments from module to module, and to a lesser extent, from flight to flight. It must be stressed, however, that the definition of the individual experiments and their associated equipment are continually changing. A detailed set of notes explaining each column on the Experiment Data Estimate Charts may be found in Appendix A.

The second set of charts, the Experiment Data Summary Charts, contains summaries of information in the Experiment Data Estimate Charts arranged by flight and by mission. Case I, the summary for missions as defined in early March 1967,* is given in Appendix B. Case II, which is given in Appendix C, is based on a later proposed set of experiment flight assignments as given in a Bellcomm memorandum by M. S. Feldman, dated June 27, 1967. Assignment of experiments to modules is based on the minutes of the March 20, 1967 meeting of the NASA Manned Space Flight Experiments Board.

The summary charts include the total bit rates which are to be obtained from the experiments on each mission if all the experiments on the mission are simultaneously generating data at the rates requested by the P.I.'s. This "requested" experiment data rate is different from the actual experiment data rate which will be transmitted because of the small variety of sampling rates available on existing Apollo and Gemini PCM systems. The actual experiment data rate is also influenced by whether a factor of two (the Nyquist rule) or something higher is used to convert from desired information bandwidth to sampling rate. This is discussed further in Appendix A.

The summary charts also include the total amount of electrical-type data generated by running each experiment at the data rates and for the duration requested by each P.I. Again, this will not be the actual number of bits received on

*The experiment flight assignments and module assignments were based on those contained in the minutes of the February 6, 1967 meeting of the NASA Manned Space Flight Experiments Board.

the ground because of changes in the rates (for reasons described above) and changes in the durations as a result of unforeseen events occurring during the mission.

The chart in Appendix D, AAP Data Summary Adjusted for Planned PCM Systems, illustrates what happens to data rates when they are adjusted for actual PCM systems and practical rather than theoretical sampling rates. It is assumed that:

1. Experiments on the Command and Service Module (CSM) use the standard Apollo PCM system, which has sampling rates of 1, 10, 50, 100, and 200 samples/sec.
2. Experiments on the Multiple Docking Adapter (MDA), Orbital Workshop (OWS), Instrumentation Unit (IU), and Apollo Telescope Mount (ATM) use standard Saturn PCM systems, with sampling rates 4, 12, 40, and 120 samples/sec.
3. More than one channel of the same sampling rate may be assigned to a single experiment with proper phasing so that, say, a 20 s/s requirement can be satisfied by using two 10 s/s channels.
4. If a sampling rate has not been specified by the P.I. for a given experiment, four times the information bandwidth is used (rather than the Nyquist rate).

It is assumed here that the number of channels needed at each sampling rate **is available**. This is not likely to be the case because of conflicts with systems status measurement requirements and hardware limitations. Some measurements which require, say, 1 s/s channels will be allocated to the next highest available channels, say, 10 s/s. This will cause the actual data rate to be even higher than those shown in Appendix D.

The estimates presented in all of the charts represent information in the references wherever possible. However, in some places it includes estimates made within Bellcomm. There are very few "fudge factors" included in the estimates; this job is left to users of this data. For example, the author shows five analog channels as outputs from an experiment only when five particular measurements can be identified. This number is not multiplied by "two" or some such "factor" to provide a "margin."

COMMENTS

The lack of proper definition of the experiments, especially in the area of data collection, has made this task quite difficult. Although an attempt is being made to present the best estimates available from the written references as well as from verbal contacts with various people at NASA Centers and Bellcomm, there are still a few areas of concern.

The P.I. may require auxiliary information to analyze his experiment in addition to the data from his experiment's sensors. For example, the time and duration of the experiment, or data from other experiments performed in the same time frame as his experiment, may have an effect on his analysis. He may also require a quick look at the performance of the experiment in real time or near real time to alter his experiment's operation or schedule. These requirements are either absent or not well-defined in the references.

Likewise, information on photographic data collection such as the type, size and volume of the film is lacking or vague in most cases. It is not certain whether the photographic film will be processed in the spacecraft or not. If it is processed in the spacecraft, it is also uncertain if any pictures are to be transmitted in real time.

In some cases, the bandwidth required for an experiment is not stated but a sampling rate is given. A reader has no idea whether the P.I. has used the Nyquist sampling rate or something higher. Further, from those cases in which both bandwidth and sampling rate are given, there does not seem to be any consistency from one experiment to another in the bandwidth-to-sampling rate conversion.

The duration of experiments is assumed to be 28 days unless otherwise indicated in the data collection period column. Although mission AAP-3/AAP-4 has a 56-day duration, it is assumed that the data collection periods of particular experiments would not be longer than 28 days, again unless otherwise indicated. Many experiments have no information concerning their duration specified in any reference.

The total number of channels for biomedical house-keeping data, indicated by an asterisk and shown in the subtotal row of the Experiment Data Summary Charts, Appendices B, C and D, are less than the algebraic sum of these channels on individual experiments since the equipment used to get the data is common

for some experiments. The number of channels available for common experiment usage is assumed to be:

3 Channels for EKG

1 Channel for Respiration Rate

1 Channel for Blood Pressure

CONCLUSION

The changes between March and July 1967, in experiment assignments and in the experiments themselves have led to a noticeable but not particularly significant reduction in both data rates and data magnitude. This may be seen in the table below, which compares desired data rates and desired total amounts of data (Some biomedical data which may or may not be counted as housekeeping data is included in the numbers below-- see Appendix A for further explanation).

	Case I (March)		Case II (July)	
	Data Rate (bits/sec)	Total Data (bits)	Data Rate (bits/sec)	Total Data (bits)
AAP 1A	---	---	3K	4×10^8
AAP 1-2	25K	7×10^9	18K	2×10^9
AAP 3-4	24K	1×10^{10}	19K	6×10^9

Even more interesting is the difference between the desired sampling rates shown above for Case II and the same rates adjusted for actual PCM systems and more realistic sampling rates. The adjusted rates are:

AAP 1-2	49KBPS	}	Adjusted rates (with EKG's)
AAP 3-4	40KBPS		

These rates are more than double the desired (and, at present, more theoretical than practical) rates. This indicates that studies of programmable PCM systems with the ability to vary sampling rates, and more optimum methods of signal sampling and reconstruction, should be investigated.

It is also noteworthy that if all EKG measurements used in experiments were recorded and transmitted as analog signals (with no sampling), then the above rates drop drastically to less than one third their values:

AAP 1-2	18KBPS	}	Adjusted rates (without EKG's)
AAP 3-4	12KBPS		

Thus, it is extremely important to consider the data handling of EKG signals. If PCM channel availability is limited, then analog handling or data compression should be strongly considered.*

Appendices A through D indicate that the biomedical and science experiments (mostly astronomical type) are the highest data generating experiments on these first five flights.



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1031-RKA-jdc

Attachments
References
Appendices A thru D

*See "Improving Space Flight Telemetry," Instrumentation Technology, July 1967 for a discussion of EKG data compression.

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7. "Experiment Interface Requirements," (Star/Horizon Automatic Tracking), Vol. VI, December 1966, Martin Company, M439.
8. "Experiment Interface Requirements," (Remote Sensor Experiments), Vol. VII, December 1966, Martin Company, E0-0A, E0-0B, E0-0C, E0-0D; M401 and M436; S021, S039, S041, S043, S044, A and B, S045, S046, S047, S048, S049, S050, S057, S060, S063, and S065.
9. "Experiment Interface Requirements," (Space Station Development), Vol. VIII, December 1966, Martin Company, D017; M423, M466, M469, M474, M479, M484, M486, M487, M488, M490, M491, M492, and M493; T003, T013, and T022.
10. "Experiment Interface Requirements," (Lunar Surface Experiments), Vol. X, December 1966, Martin Company, M455, M457, M458, A and B.
11. "Saturn/Apollo Applications Program - Experiment Definitions;" Mission 209 Cluster #4900211, November 23, 1966, Lockheed Aircraft, Sunnyvale, California, M018, M050, M051, M052, M053, M054, and M055; M466, M469, M479, M484, M486, M487, M489, M491, M492; T017, T020, T021, and T022.

References (Cont'd)

12. "Saturn/Apollo Applications Program, Experiment Definitions;" Mission A-1 Cluster, Document #4900217, December 14, 1966, Lockheed Missiles and Space Company, Division of Lockheed Spacecraft, Sunnyvale, California, D017, T004, T012; E0-0; S009; M401.
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14. "Saturn/Apollo Applications Solar, ATM Parametric Constraints," (Revised), January 12, 1967, Lockheed Missiles and Space Company, Division of Lockheed Spacecraft, Sunnyvale, California.
15. Personal Communication Between Author and Mr . T. Duggan, and Messrs. R. M. Hargrove, and R. Smith of Aerospace Laboratory, MSFC, Huntsville, Alabama, March 1967, and July 25, 1967.
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 - (a) X-ray Astronomy, July 1, 1966
 - (b) X-ray Sky Mapping, July 1, 1966
 - (c) Proposal to NASA by Physics Department of the University of Wisconsin, #50-002(048), August 2, 1965.
17. NAA Report No. SI 65-15-37-3, April 1966.
18. ATM Quarterly Technical Review Report, March 8, 1967, MSFC, Huntsville, Alabama.
19. Final Report on Apollo Telescope Mount, April 1, 1966, Ball Brothers, Boulder, Colorado.
20. Experiment Data Sheets, MSFC Form 2484, February 15, 1967, March 2, 1967, March 20, 1967.
21. MSC Comments on the author's memorandum, "Data Generated by Experiments on AAP Missions 1/2 and 3/4," issued as Working Papers in March 1967.

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APPENDIX A

Experiment Data Estimate Charts

A. Symbols Used in the Charts

1. A "?" by itself indicates a lack of available information, and when following a word or piece of data, it indicates high uncertainty in the estimate.
2. A "? ft. of ? film" means the footage and type of film are unknown.
3. Parentheses "()" around a number indicate that the number was taken directly from one of the references and is not an estimate by the author. Sometimes two numbers are given with one in parentheses. This is used whenever the author's estimate is different from that in the references.
4. An "*" is used for biomedical measurements which are required for a particular experiment but may also be required as part of standard housekeeping data. It is shown explicitly because the experiments may cause more frequent or longer biomedical data collection than would be required by housekeeping alone, or may use experiment sensors independent of sensors used for crew safety data. It is a significant amount of data, and since it is needed to interpret the experiments, may be of concern for sizing experiment data archives.

B. Explanation of Columns on the Data Estimate Charts

The following sections discuss the various columns on the Data Estimate Charts:

Experiment Number

There are three numbers shown (if they exist) to identify each experiment. The first conforms to the most recent NASA Headquarters numbering system; the second is the old, assorted NASA numbers; the third is the numbering system used in the Bellcomm experiment files.

Experiment Name

In many cases, the name listed is one of several associated with the experiment.

Appendix A

In-Flight Data Collection Period

The title refers to periods during which data is collected. This is not always the same as the periods during which astronauts are working on the experiment; it does not include set-up and tear-down times, for example, but does include periods of automatic or nonsupervised data collection.

Unless otherwise specified, it is assumed that all channels associated with an experiment are outputting data during the data collection periods shown.

Nature or Source of Data

Either a device or a type of data is listed.

Number of Channels

It is assumed that each individual measurement has its own output channel, unless otherwise specified.

Type

Possible types of channels for electrical signals coming from experiments but before being sampled are Analog (A), Digital (D), and Bi-Level (Bi-L). Bi-Level refers to channels which handle discrete binary information of the on-off, open-closed variety. Nonelectrical data which are physically recovered, such as film and specimens, have an (R) in this column.

Bandwidth

Analog channels are assumed to be of narrow, medium, or wide bandwidth, where:

Narrow is defined as 0-100 Hz.

Medium is defined as 100-300 Hz.

Wide is defined as >3000 Hz.

The idea behind this categorization is that narrow bandwidth analog data can be sampled, and that medium bandwidth data can be transmitted via a voice-grade channel.

Appendix A

Samples Per Second

Whenever possible, sampling rates specified by P.I.'s are used. If the bandwidth but not the sampling rate is given, the Nyquist sampling rate (twice the highest frequency) is used. If neither is given, estimates are made by analogy to known measurements. In particular, temperatures are assumed to be sampled at a rate of 1 sample per second, and voltages, currents, flow rates, and pressures at 1-10 samples per second. These are the rates for similar measurements in the Apollo spacecraft.

It may be argued that in the cases where only the bandwidth is known, one should not use the Nyquist rate (theoretically, the minimum sampling rate) but rather a factor of 3-5 times the highest frequency, i.e., 1.5-2.5 times the Nyquist rate. This factor is often used in spaceborne telemetry of systems data to ensure recovering the desired highest frequencies without distortion introduced by real-world equipment and communications channels. However, the experiment data telemetered to the ground is unlikely to require high precision processing in real-time. It may, therefore, be possible to use sampling rates closer to the theoretical rates and use more sophisticated digital processing to reconstruct the sampled signal--in other words, trade reconstruction time for precision. Furthermore, judging from the lack of precise data handling definitions currently available on these experiments and the widespread tendency to overestimate sampling rates in the face of uncertainty, the bandwidths quoted in the references are probably on the high side of what are actually required. Thus the Nyquist rate is used as described in order to estimate lower bounds for the data rates from the various experiments. Higher, more realistic, and more likely estimates are given in Appendix D.

Total Bits Per Second

It has been assumed that all samples of analog signals are converted into 8 bit words unless otherwise specified (e.g., ATM experiments and S027 are specified as 10 bit formats). It has also been assumed that all digital channel information is encoded in 8 bit words (ATM and S027 excepted). Thus, the data in the bits per second column are usually calculated from:
$$\text{bits/second} = (\text{no. of channels})(\text{sampling rate per channel})(8 \text{ bits per sample}).$$

Appendix A

Sometimes an experimenter requests more or less than 8 bits/sample because of a greater or lesser accuracy requirement. This will be shown by putting the experimenter's bits/sec. figure in parentheses, underneath the corresponding figure using 8 bits/sample.

Total Amount of Data From Experiment (Desired)

Total digital and sampled (narrow band) analog data from each experiment are added together and expressed in bits. Total bits are calculated from:

Total no.of bits = total data collection time (seconds) x bits/sec.

For medium or wideband data, the total data is expressed in terms of medium or wideband channel-hours. Ten channel-hours could be 10 channels generating for one hour or one channel for 10 hours. For photographic data the number of photos or feet of film is used for total data.

It is important to realize that the "Desired Total Amount of Data" is the amount requested by the experimenter, and not the actual total received on the ground. The actual total received will be increased by the permanent assignment of particular PCM input channels to particular experiment measurements for an entire mission. Data will be collected from a channel whenever it is sampled, regardless of whether or not the experiment associated with that channel is operating. The actual total received will be decreased by factors such as lack of available astronaut time to complete an experiment, malfunctioning of experiment equipment, and mission contingencies.

Requires Information on S/C Attitude or Trajectory

Many experiments require knowledge of the spacecraft's trajectory or attitude (and attitude rates) for post-flight analyses. This need is indicated by a "yes" in the appropriate column. Dashes mean "no" or "not applicable."

Real Time Voice During Experiment

In some experiments there is a requirement for voice communications with the ground during the performance of the experiment. An "x" in this column indicates this requirement is necessary or highly desirable.

Appendix A

References

All written information available to and used by the author on each experiment is indicated in this column. A list is included which gives all the references indicated in this column. The forms referred to are standard NASA forms for experiments. Form 1138 (recently replaced by Form 1146) is the proposal which the Principal Investigator has to submit for his particular experiment. A new form, 1147, entitled "Experiment Implementation Plan" (EIP), is prepared by NASA for each experiment and expands upon the 1146 form.

Remarks

In some cases, a discrepancy has been found in comparing different references for a particular experiment. An attempt is made to indicate such discrepancies (when they were not obviously outdated) or any other important information not covered in any other column, such as the use of a computer to process the data on board the spacecraft.

AAP EXPERIMENTS DATA ESTIMATES

DOD

July 25, 1967

Experiment No.	Experiment Name	Infiniti Dev. Collec. & Perfrds	Source or Type of Chan.	Bandwidth (Hz)	Sample per sec.	Total Bits/sec.	5.12 /mount of Data (From Expt. Desired)	Required Info. on C/C Att. Traj.	References	Real Time Voice During Expt.	Notes
D017 D-17 E0145	CO ₂ Reduction	4 to 6 hours	Electrolytic cell voltage, current and temperature	(3) A --	(1) A --	56	8.1 x 10 ⁵ 1.2 x 10 ⁵ bits	--	--	X	Equipment must be recovered for post flight examination. According to Lockheed, data acquisition time is 10 min/hr for 3 hours.
			CO ₂ -CO temperature and pressure	(2) A --					Form 1067 Equivalent References 1,9,12 & 21		
			Oxygen temperature and pressure	(2) A --							
D018 D-18 E0522	Integrated Maintenance	39 hours	Slow motion pictures of task being performed.	R --	6 frames per sec	--	? feet of ? film	--	Form NHQ-6, 2/66; Form 1138, 9/66, References 1, 20, & 21	X	Form NHQ-6 indicates a TV coverage of 5 Min transmitter EIN.
			Taped voice and written notes.	A/R --							Expt. may use operational equipment, which would add some parameters to be measured (probably measured anyhow as part of systems housekeeping data).

AAP EXPERIMENTS DATA ESTIMATES

DOD

July 25, 1967

Experiment No.	Experiment Name	Inflight Data Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (HZ)	Sample per sec	Total Bits/sec.	Total amount of Data from Expt. (Desired)	Requires info. on S/C Att. Traj.		References	Real Time Voice During Expt.	Notes
										Att.	Traj.			
D019 D-19 E10574	Suit Donning and Sleep Station Evaluation	3 hours	Motion Pictures Taped voice and written notes	-- R -- A/R	-- --	-- 6 frames per sec	--	? feet of ? film	--	--	--	Form NHQ-5, 6/66; Form 1138, 9/66; References 1, 5, 20 & 21	x	
D020 D-20 E10682	Alternate Restraints Evaluation	2 hours	Motion Pictures Taped voice or written notes	-- R -- A/R	-- --	-- --	--	? feet of ? film	--	--	--	Form 1138, 9/66; References 1, 5, 20 & 21	x	Voice comments on expts. D-18 and D-20 would probably be recorded simultaneously.
D021 D-21 E10683	Expandable Airlock Technology	193 minutes continuous	Motion Pictures Motion Pictures	-- R -- R	-- --	-- 16 frames per sec	-- 6 frames per sec	? feet of 16 mm film; ? feet of 35 mm film;	--	--	--	Form 1138, 9/66; References 1, 5, 13, 20 & 21	x	P.I. has requested biomed data which may be collected during the expt. Allocation of temperature and pressure are as follows: 4 Outer surface temperature 2 Inner surface temperature 2 Airlock pressures
		193 minutes continuous; 5 sec/session, 6 sessions/day for 2 days 2 sessions/day for 13 days Total: ~3.3 hours	Thermistors (5) Pressure sensors Specimen of airlock wall structure Taped voice notes Biomed data	(5) A (2) A (2) A	(2) (2) (2)	4 256 3.0 x 10 ⁶ bits + 1*	4 4							

AAP EXPERIMENTS DATA ESTIMATES

DOD

July 25, 1967

Experiment No.	Experiment Name	Inflight Data Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (HZ)	Sample per sec	Total Bits/sec.	Total Amount of Data from Expt. (Desired)	Requires Info. on S/C Att.	References	Real Time Noise During Expt.	Notes
DOD										Att.	Traj.		
D022 D-22 E10684	Expendable Structure for Recovery	15 sec./measurement/15 min. interval for first 15 days after acquiring orbit. Possibly 2 measurements per orbit for rest of the flight and 30 min. of continuous measurement at end of flight. Total: ~3-10 hours	Motion pictures Still pictures Temperature Pressure Calibration Taped voice or written notes Vibrations	-- -- (15) (4) (3) -- 1?	R R A A A A/R A?	-- -- (2) (2) (2) -- Medium	16 frames per sec -- -- 704 -- --	1 feet of 16 mm film; 7.5 x 10 ⁶ 2.5 x 10 ⁷ bits 3-10 medium band channel hours	-- -- 4 4 4 -- --	Lockheed ENCAPS-TVB Definitive Experiment Plan, 2/67; References I, 5, 13 20 & 21	X		

AAP EXPERIMENTS DATA ESTIMATES

MEDICAL

July 25, 1967

Experiment No.	Experiment Name	Inflight Data Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (Hz)	Sample per sec	Total Bits/sec.	Total Amount of Data from Expt. (Desired)	Requires Info. on S/C Att.	References	Real Time Voice Recording Expt.	Notes
M050 M-20 EXP170	Inflight Vectorcardiogram	15 min/astro./day. Total: ~ 13 hrs. (Experiment starts after 7 ± 1 days and runs only for next 17 days)	Frank's vectorcar- diogram	(3)	A	(0.2 - 100)	200	4800			Form 1067, 2/65; MAA Report, 12/65; Form 1138, 8/66; References 1, 3, 11, 20 & 21; EXP, 3/31/67		
			Respiration (pneumo- graph) con- dition	(1)	A	(10)	20*	160*	2.3 × 10 ⁸ + 6*	--			
			Bicycle ergometer	(1)	A	(1)	2	16	7.5 × 10 bits	--			
M050 M-20 EXP170	Metabolic Activity	9 hours/astro./28 days Total: 27 hours for 28 days flight; 12 hours/Astro./56 days Total: 36 hours for 56 days flight	Gas chromato- graph	(2)	A	(10)	20	320		--	Form 1138, 8/66; References 1, 3, 4, 11 and 20; EXP, 3/21/67	X	
			Flow rate	(1)	A	(10)	20	160					
			Temperature	(1)	A	(1)	2	16	5 × 10 ⁶ - 6 × 10 ⁷				
			Respiration rate* (Low quality sam- ple rate)	(1)	A	(1)	2 *	16*	1.8 × 10 ⁷ - 1.7 × 10 ⁸ * bits for 28 days mission; 6.6 × 10 ⁶ - 5 × 10 ⁷ bits				
			Heart* rate	(1)	A	(10)	20*	160*	+ 2.4 × 10 ⁷ * - 2.0 × 10 ⁸ * bits				
			Metabolic rate	(1)	A	(10)	20	160	for 56 days mission				

AAP EXPERIMENTS DATA ESTIMATES

MEDICAL

July 25, 1967

Experiment No.	Experiment Name	Inflight Date Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (Hz)	Sample per sec	Total B-t/s/sec.	Total Amount of Data from Expt. (Desired)	Requires info. on S/C Att.	References	Real Time Voice During Exp.	Notes
M051 M-51 EJ0630	Cardiovascular Function Assessment	30 min/astro./3 day (Expt.arts on each astro. at 192 ± 48 hrs and then repeats on each one at intervals of 72 ± 3 hours. Last 4 days of flight are unusable time)	EKG* Blood pressure*	(3)	A	(100)	200*	4800*	Form 1138, 6/66; References 1, 3, 11, 20 & 21	--	Form 1138 has the following measurements, called the "basic parameters," which were not found in any other references 1. Fluid intake/outtake 2. Electrolytes 3. Circulation time Onboard physician-astronaut is required and some medical results will be evaluated. Ref. 11 (Lockheed) shows only one analog channel and data collection period of 8 min./astro./3 days.		
M052 M-52 EJ0678	Bone and Muscle Changes	Approx. 30 min/day.	Urine specimen (either dried or in a preservation	--	R	--	3 - 6 specimens per day	--	Form 1138, 6/66; References 3, 11, 20 & 21; EIP, 4/6/67	--			
M053 M-53 EJ0679	Human Vestibular Function	Conducted on each astronaut every other day. (1 hr./day)	Written notes on food and water intake to take on each astronaut.	--	R	--	--	--	Form 1138, 6/66; References 1, 3, 11, 20 & 21	Yes?	7 ft. or ? film; 5.0 x 10 ⁵ bits	X	

Measurements of acceleration along 3-axes are required during test soggles and chair experiments as follows;
 Pipe counters x, y, z axes & actual CPU x, y, z axes from onboard computer down list.

Measurements (1)	A	(.25)	4
From test			
Goggles TV Pictures?			
Motion pictures	--	R	--
Timing & I. D.	(1)	E-L	1

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Experiment No.	Experiment Name	Inflight Data Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (HZ)	Sample per sec	Total Bits/sec.	Total amount of Data from Exp. (Desired)	Requires info. on S/C Att.	Ref.	Real time voice During Expt.	Notes
MOS ⁴ N-54 ES0166	Neurological Study (EEG)	Continuous for one astro from launch through 2 orbits; each sleep period; and beginning of last 2 orbits through recovery Total: 8 hrs. + 6 hrs./day (sleep)	EEG	(2)	A	(100)	200	3200	4.1×10^9 bits + 7.6×10^8 * bits	--	EIP, 12/66; References 1, 3, & 11	--	Reference 11 (Lockheed) shows two analog channels.
			EOG	(2)	A	(100)	200	3200					
			ECG*	(1)	A	--	100*	800*					
			Respiration*	(1)	A	--	50*	400*					
MOS ⁵ N-55 ES0337	Time and Motion Study	Periodic filming of astronaut performing selected tasks for a period of 20 days	Motion pictures	--	R	--	--	? ft. of 16 mm film	--	--	Form 1138; References 1, 3, 11, 20, & 21	--	
			Taped voice notes	--	A/R	--	--	---					

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Experiment No.	Experiment Name	Inflight Data Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (Hz)	Sample per sec	Total Bits/sec.	Total amount of Data from Expt. (Desired)	Requires info. on S/C into, on S/C	Real Time Voice During Expt.	Notes
										Att.	Ref.	
M401 ESF E1505	Lunar Mapping and Survey Photography	Total: ~17.5 hours for a 4 day photo mission	Metric camera	--	R	--	--	--	? feet of 9.5" film (9" x 9" frame);	Yes	Form 1067, 6/65; References 1, 8, 12 & 22	X
			Stellar camera	--	R	--	--	--	? feet of 35mm film;			
			Ultra hi-resolution photography (two I.R. and two visible cameras)	--	R	--	--	--	? feet of 75 mm film;			
			Status measurement	2?	A	?	1?	16?	2.8 x 10 ⁸ bits?			
			Elect. data	2?	A?	?	?	1000, 3500				
M402 E1418	Spent Stage Habitability (orbital workshop)	14 days?	Photograph	--	R	--	--	--	? feet of ? film	--	Form 1067, 2/66; Form 154, 9/65; DTDBC 10/66;	?
M439 E10567	Star-Horizon Automatic Tracking	5 min/observation; 32 observations. Total: ~ 2.5 hours?	Photometer output	(1)	D	--	(1)	8	7.2 x 10 ⁴ bits	Yes	Form 1138, 6/66; References 1, 7, & 22; EIP, 11/2/66	?
			Taped voice or written notes	--	A/R	--	--	--			Reference 1 (Martin) shows 8 min/observation.	
											P.I. requests computation of "horizon altitude" by command module computer; not necessary however.	
											Certain guidance system measurements are required by this expt.	

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Experiment No.	Experiment Name	In-Flight Date Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (HZ)	Sample per sec.	Total Bits/sec.	Total Amount of Data from Expt. (Desired)	Requires info. on S/C		References	Traj.	Real time voice during expt.	Notes
										Att.	Yes				
M666 E0556	Suits and Lunar Hardware	3 hr./session for 3 sessions/day for two days Total: 18 hours	Normal* EVA Data Battery voltage, suit inlet temp., and pressure, O_2 quantity, water temp., water quantity.	(6)	A	(12)	24*	1632*	1.5×10^8 *			Form 1138, 6/66; RDP, 9/66; References 1, 9 & 11	X		
			EKG*	(1)	A	(30)	60*		5.2×10^6 bits						
			PASS EKG*	(1)	A	(30)	60*								
			Respiration*	(1)	A	10	20*	160*							
			Body & skin temp., CO_2 in & out, dew point in & out, air temp., H_2O temp., in & out, suit gas flow	(10)	A	-----	-----	1	80						
			Taped voice or written notes	--	A/R	-----	-----	-----	-----						
		Approximately 130 min./ day for two days.	Motion Pictures	--	R	--	--	--	--						

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Experiment No.	Experiment Name	Inflight Data Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (Hz)	Sample per sec	Total Bits/sec.	Total Amount of Data from Expt. (Desired)	Requires info. on S/C Att.	Refra.j.	References	Real Time Voice During Expt.	Notes
M469 MRFC31 ET0234	SP-124 Removal and Disassembly	Total: ~5.2 hours of which 45 min. is EVA for one day.	Normal EVA Data*	(1)	A	(30)	60*	1632*	4.4×10^6 * bits	--	--	Form 1138, 6/66; EDP, 9/66; References 1, 9, 11, 20 & 21	X	References 1 & 9 (Martin) mention 8 mm film to be used. References 20 call for single channel which carry four unspecified measurements. It is not clear whether normal, special or no biomed data is collected in this expt.
			Motor current and temp., impactor output, tool handle torque	(6)	A	(12)	24*	+ .	8.6×10^4 bits;					
		1 hr?	Motion Pictures (Orbital assembly & dis-assembly, maintenance & repair)	(1)	A	-----	(1)	32						
					R	-----	1 frame per sec.	-----	7 feet of 16 mm film					
			Taped voice or (and) written notes	--	A/R	-----	-----	-----						
M479 ET0486	Zero Gravity Flammability	6 sec/test, 76 tests Total: ~ 8 min.	Pressure changes in combustion chamber	(1)	A	-----	(1)	8	3.8×10^3 bits;			Form 1138, 9/66; References 1, 9, 11, & 20	--	References 11 (Lockheed) & 20 show 11 minutes & 7.5 minutes of data collection. Real time data may be required.
			Motion Pictures (Ignition of solid materials in a controlled atmosphere under weightlessness)	--	R	-----			1120 feet of 16 mm film					
									16 frames per sec.					
			Taped voice and written notes	--	A/R	-----	-----	-----						

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Experiment No.	Experiment Name	Inflight Date, Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (Hz)	Sample per sec	Total Bits/sec.	Total amount of Data from Expt. (Desired)	Requires info. on S/C		References	Real Time Voice During Expt.	Notes
										Att.	Traj.			
M487 E10582	Habitability and Crew Quarters	4 hours	Motion pictures	--	R	-----	--	--	2 feet of 16mm film	---	---	Form 1138, 6/66; EDP 9/66; References 1, 9, 11, & 13	X	
			TV tape?	--	R?	-----	--	--						
			Taped voice notes	--	A/R	-----	--	--						
M488 E10580	High Pressure Gas Expulsion	120 sec. period/30 min. intervals over 6, 8, & 20 hour experiment sessions Total: ~ 1.7 hours	Temperatures & pressures	(10)	A	-----	(1)	80	5.0 x 10 ⁵ bits;	---	---	Form 1138, 6/66; References 1, 9, 11, 13, & 20	--	Reference 1 (Martin) shows data collection for 20 minutes total. Reference 20 describes sampling rate of 1 to 2 s/s as "not critical."
			Motion pictures	--	R	-----	--	--	2 feet of 16mm film					
			Taped voice notes	--	A/R	-----	--	--						
M489 E10681	Heat Exchange Service	3 trials of 6.66 hours each Total: ~ 20 hours	Flow rate, temp. and pressure	(14)	A	-----	(1)	112	8.0 x 10 ⁶ bits;	---	---	Form 1138, 9/66; References 1, 9, 11, 13, & 20	--	Reference 20 describes sampling rate of 1 to 2 s/s as "not critical."
			Motion pictures	--	R	-----	--	--						
			Taped voice or written notes	--	A/R	-----	--	--						

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Experiment No.	Experiment Name	InFlight Data Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (HZ)	Sample per sec	Total Bits/sec.	Total Amount of Data from Exp. (Desired)	Requires info. on S/C Att. Traj.	References	Real Time Voice During Event.	Notes
M491 E10593	Surface Absorbed Materials	2 EVA periods of 30 min. each. Total: ~ 1 hr. of EVA	Collection of specimen slides	--	R	----	--	--	6.0 x 10 ^{6*} bits	--	Form 1138, 9/66; References 9, 11 & 13	X	
M492 MSFC-142 E1590	Tube Joining in Space	Approximately 1 hr.	Normal EVA* data	(6) (1)	A A	(12) (30)	(24)* (60)*	1632*					
M493 MSFC-36 E1091	Electron Beam Welding	1 hour	Motion pictures	--	R	----	16 frames per sec	--	1000 feet of 8 mm film;	--	Form 1138, 6/66; EDP, 9/66; References 1, 13 & 20	X	
			Taped voice or written notes	--	A/R	----	--	--					
			Tube Joints specimen package	--	R	----	--	--					
			Motion pictures color	--	R	----	16 frames per sec	--	? feet of ? film	--	Form 1138, 6/66; References 1, 11, 13 & 20	X	
			Motion pictures black & white	--	R	----	6 frames per sec	--					
			Welding specimens	--	R	----	--	--					
M508 (M486A)	Astronaut EVA Hardware Evaluation	8 task sessions of 2 hrs each. Total: ~ 16 hrs. (400 minutes of motion pictures)	Motion pictures	--	R	----	6 frames per sec	--	? feet of ? film	--	EIP (draft), 4/4/67	X	
			Motion pictures	--	R	----	24 frames per sec	--	? bits				
			Biomed tape recorder	?	A/R	?	?	?					
			Taped voice and written notes	--	A/R	----	--	--					

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Experiment No.	Experiment Name	Inflight Data Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (HZ)	Sample per sec	Total Bits/sec.	Total amount of Data from Expt. (Desired)	Requires info. on S/C info. on S/C	References	Real Time Voice During Expt.	Notes
										Att.	Traj.		
N509 (M668)	Astronaut Maneuvering Evaluation	3 task sessions of 3.5 hrs. each Total: ~10.5 hours	Motion Pictures	--	R	----	6 frames per sec	--	2700 Feet of ? film	--	--	EIP (draft), 3/8/67	Voice and biomedical telemetry required for normal flight operations may be used to satisfy the data requirement for this expt.
			Motion Pictures	--	R	----	24 frames per sec	--	? feet of ? film				
			Biomed tape recorder	?	A/R	?	?	?	? bits				
			Taped voice notes	--	A/R	----	--	--					

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Experiment No.	Experiment Name	Inflight Data Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (Hz)	Sample per sec	Total Bits/sec.	Total Amount of Data from Expt. (Desired)	Requires info. on S/C		Real Time Voice During Expt.	Notes
										Att.	Trsl.	References	
9005 E9014	Synoptic Terrain Photography	45 minutes	Still Pictures	--	R	--	--	--	40 photos	Yes	Yes	Form 1067, 4/64; DBP, 10/66; References 1, 20 & 21	--
9006 E90275	Synoptic Weather Photography	10 minutes/target Total: 100 minutes	Photography Taped voice or written notes	--	A/R	--	--	--	? feet of ? film	Yes	Yes	Form 1138, 9/66; References 1, 20 & 21	--
9009 E9013	Nuclear Emulsion	5 sec. every 5 min. for 92 to 100 hours Total: 1.6 hrs.	Emulsion package	--	R	--	--	--	1.9 x 10 ⁵ bits	Yes	Yes	Tromba (OSSA) Package; Form 1138, 9/66; References 1, 4, 12, 20 & 21	X
9015 E90400	Zero-G Single Human Cells	Performed first thirteen days	Temperature	(1)	A	(1)	(1)	(2)	16				
			Stack movement	(1)	A	(1)	(1)	(2)	16				
			Phase contrast time lapse motion picture	--	R	--	--	--	750 feet of 16 mm film	--	--	Form 1138, 11/64; References 1, 3 & 21	--
			Taped voice or written notes	--	A/R	--	--	--					
			Special microscopy specimens	--	R	--	--	--					
9016 E9013	Trapped Particles Asymmetry	Between 5 and 16 minutes per orbit for seven consecutive orbits per day for a total time of 86 min/day.	Nuclear emulsion package	--	R	--	--	--		Yes	Yes	Form 1067, 12/64; Form 1138, 9/64	--
													Information on components of magnetic field as a function of altitude, longitude and latitude in anomalous region is required. Emulsion package to be recovered 1-2 orbits before re-entry.

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Experiment No.	Experiment Name	Inflight Data Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (HZ)	Sample per sec	Total Bits/sec.	Total Amount of Data from Exp. (Desired)	Requires info. on S/C from Exp.	References	Real Time Voice During Exp.	Notes
										Att.	Att.	Traj.	
SO17 EI-0103	X-ray Astronomy	30 min. observation for minimum of 10 hours	Computer, detector banks 1 & photomultiplier outputs	A	? ¹	1600	5.8×10^7 bits;	Yes	ATT proposal, 9/64; References 1 & 6	--	Has its own TM system, including a tape recorder with 6.4Kbps dump capability.		
			Photography	--	R	--	--	--			1.6Kbps exp. output includes attitude information from Apollo Guidance Computer.		
SO18 EI-0380	Micrometeoroid Collection	> 8 hours	Taped voice notes and/or written notes	--	A/R	--	--	--	--	--	Form 1138, 7/65; References 20 & 21	X	
SO19 EI-0102	Ultraviolet Stellar Astronomy	10 min./observation, dark	Taped voice notes	--	A/R	--	--	--	0.02 - 3.8×10^6 bits;	Yes	Form 1138, 5/65; U.S. Naval Research Laboratory Proposal, 3/66; Reference 21	--	Vertical or written mark required at the beginning and end of each exposure.
		4 observations/side of orbit, 400 observations Total: ~66 • 7 hours	Photos by spectrograph	--	R	--	--	--	Approximately 10,000 photos? (35 mm slides + 13½ -inch band channel hours?)				
SO20 EI-0394	UV & X-Ray Solar Photography	Total of 6 hours during the dark side of several orbits for 8 days	Film of extreme UV & X-ray spectrum	--	R	--	--	--	10 film strip, 1.7×10^5 bits	Yes	Form 1067, 3/65; Form 1138, 1/65; References 20 & 21	--	
			Status measurement	(1)	A	--	(1)	1	0-16				
			Written notes	--	R	--	--	--					
SO27 EI-0425	Galactic X-Ray Mapping	5 - 6 hours	Sky scanning equipment (counters, star sensor, etc.)	(60)	D	--	(1)	(600)	? feet of ? film; $2.9 \times 3.5 \times 10^7$ bits	Yes	References 1, 16, 20 & 21	X?	Some references specify 10 bit word for digital channels. Not clear it is necessary.
			Monitoring	(25)	A	--	(1)	(1,000)					
			Photography	--	R	--	--	--					

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Scientific Experiment No.	Experiment Name	Inflight Data Collector Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (Hz)	Sample per sec	Total Bits/sec.	Total Amount of Data from Expt. (Desired)	Requires info. on S/C Att. Traj.	References	Real Time Voice During Exp.	Notes
EE0-III E20465	Apollo Telescope Mount (ATM)	During the flight	Taped voice or written notes on all ATM experiments	--	A/R	--	--	--	--	Yes	High Altitude Observatory Proposal, References 1, 14, 15, 17, 18, 19 & 21; EIP, 4/3/67	X	All ATM experiments have status measurements (temperatures, voltages, film footage monitoring, etc.), sometimes referred to as "standard mode" or "housekeeping data".
S052 E20463	White Light Coronagraph (High Altitude Observatory)	Patrol mode: (includes status measurements) 40 min. max./orbit Total: ~100 - 300 hours?? Active mode: 20 min. max./orbit Total: ~60 - 100 hours??	Photographs of sun	--	R	--	--	--	? feet of 35mm film;	Yes	High Altitude Observatory Proposal, References 1, 14, 15, 17, 18, 19 & 21; EIP, 4/3/67	X	The duration for which each experiment will run is not clearly defined at present. Most of the ATM measurements are converted into 10 bit words.
S053 E20454	UV Spectroheliograph and XUV Spectrograph	Patrol mode: (includes status measurements) 40 min. max./orbit Total: ~100 - 300 hours?? Active mode: 20 min. max./orbit Total: ~30 hours ??	Photography	--	R	--	--	--	2.5 x 10 ⁸ - 6.3 x 10 ⁸ bits	Yes	High Altitude Observatory Proposal, References 1, 14, 15, 17, 18, 19 & 21; EIP, 4/3/67	X	Patrolling and data collection is confined to the sunlight side of the orbits.
S054 E20459	X-Ray Spectroheliograph (American Science & Eng., Inc.)	Patrol mode: (includes status measurements) 40 min. max./orbit Total: ~100 - 200 hours?? Active mode: 20 min. max./orbit Total: ~98 hours	Status measurements	(10)	A	--	(4)	440	1000 - 3000 ft. of 70 mm film;	Yes	References 1, 14, 15, 17, 18 & 21; EIP, 4/3/67	X	During Patrol mode, a minimum of 4 pictures are taken for each 12 hours period. Utmost importance will be to have the capability for P. I. to study the "Quick Look" facsimiles and to update the observing sequence via voice communication. These measurements are at 24 s/s but have different bits/sample formats than 10 bits/sample.
S055 E20464	UV Spectrometer and UV Spectrohelimeter (Harvard College Observatory)	Patrol mode: (includes status measurements) 40 min. max./orbit Total: ~100 - 300 hours?? Active mode: 20 min. max./orbit Total: ~60 - 100 hours??	Photography	--	R	--	--	(280)	? feet of ? film;	Yes	References 1, 6, 14, 15, 17, 18 & 21; EIP, 4/3/67	X	†† Single measurement of 20 bits/sample.
S056 E20465	X-Ray/XUV Telescope (Goddard Space Flight Center)	Patrol mode: (includes status measurements) 40 min. max./orbit Total: ~100-300 hours?? Active mode: 20 min. max./orbit Total: ~60 - 100 hours??	Photoelectric sensors	(10)	A & D	--	(24)	1.6 x 10 ⁹ - 3.5 x 10 ⁹ bits	2000 ft. of 35mm film;	Yes	Harvard College Proposal, References 1, 14, 15, 17, 18, 19 & 21; EIP, 4/3/67	X	Some of the measurements are recorded on a tape recorder (ASAP) simultaneously with R/T data. The recorded data is dumped over the tracking station. The recorder has a capability of 3.88Kbps and this capability is mostly used at present.
			Photoelectric sensors	(40)	A	--	(4)	1720	1.2 x 10 ⁸ bits	(80) ††	GSPC X-614-66-138, References 1, 14, 15, 17, 18, 19 & 21; EIP, 4/3/67	X	
			Status measurements	(30)	Bi-L	--	(4)	820		(4)			

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Experiment No.	Experiment Name	InFlight Data Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (HZ)	Sample per sec	Total Bits/sec.	Total amount of Data from Expt. (Desired)	Requires Info. on S/C	References	Real Time Voice Expt.	Notes
										Att.	Traj.		
S061 EJ063	Potato Respiration	15 sec. period/6 min. throughout the flight. Total: ~ 22.4 hours	Oxygen consumption	(1)	D	--	1/(60)	8	6.7 x 10 ⁵ bits	--	Form 1138, 1/66; References 1 & 3; EIP, 11/7/66	--	
S063 S-63 EJ0119	Airflow Photography	Three Performances: Two for 60 minutes and one for 80 minutes Total: ~ 3.33 hours	Visible and U. V. range photographs	--	R	--	8-12 photos/ orbit	--	30-40 photos?	Yes	Form 1138, 4/65, 9/66; References 20 & 21	X?	
			Start & stop signal for each exposure and duration of exposure	(10)	Bi-L	--	1	10	1.2 x 10 ⁵ bits				
			Taped voice and written notes	--	A/R	--	--	--	--				
			Photography	--	R	--	--	--	? feet of ? film	Yes	References 1, 2, 20 & 21; EIP, 11/10/66	--	
S065 EJ0694	Multi-Band Terrain Photography	Total: ~ 45 minutes (4 sessions)	Taped voice notes on exposure, filter number, area covered, camera set- ting, position and altitude	--	A/R	--	--	--					
S069 EJ0103	X-Ray Astronomy	30 min/observation for minimum of 10 hours	Star sensor photomultiplier & X-ray detector banks outputs	1	A	?	?	1600	5.8 x 10 ⁷ bits;	yes	M.I.T. Proposal, 9/66; EIP, 11/66; References 1, 6, 20 & 21	--	Has its own 1.6KIPS TIM system that is integral part of the experiment. Data is stored on a tape recorder and dumped 4 times faster over a tracking station.
			Photography	--	R	--	--	--	? feet of 16mm film				

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Experiment No.	Experiment Name	Inflight Det. Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (Hz)	Sample per sec	Total Amount of Data from Expt. (Desired)	Requires info. on S/C	References	Real Time Voice During Expt.	Notes	
									Att.	Traj.			
T002 E0264	Manned Navigation Sighting	2 min/sighting for about 50 sighting periods (55 orbits will be necessary to complete the experiment) Total: ~2 hours	Status meas (Cabin temp & pressure) Taped voice and written notes on the different sighting information	2	A	--	1	16	1.1 x 10 ⁵ bits	Yes	Form 1067, 8/64; References 1, 5 & 12	X	Reference 12 (Lockheed) mentions 16 sighting periods on the dark side.
T003 E0180	In-flight Nephelometer	Starts immediately after entering orbit. 2 min. for instru- ment operation and 1 min to log information at 4 hour intervals during astronaut's working day.	Logging data displayed on the in- strument panel & collection of samples.	--	R	--	--	--	--	Form 1067, 5/65; DEP, 5/66	X	Results of the measurements should be relayed to ground via voice communication.	
T004 E0180	Frog Otolith Function	8 min/session for 44 sessions. Total: ~6 hours	EEG on two frogs	(2)	A	(30)	60	960	10 medium band channel hours	Yes	Form 1067, 11/64; Proposal, NASA Ames, Res. Center; 1, 3, 12& 20	X	Data on spacecart's acceler- ation along 3-axes would be required. Reference 1 (Martin) gives only 4 channels on two frogs for EEG and EMG.
		Test cycles to be completed by end of first 72 hrs in orbit.	Two otoliths on two frogs (nerve sig- nal)	(4)	A	(500)	--	--	3.2 x 10 ⁷ bits				
			Frog acceler- ometer	(1)	A	(10)	20	160					
			Life support temperature and pres- sure	(2)	A	(10)	20	320					
			Time pulse	(1)	Bi-L	--	1	1					
			Water pump tachometer	(1)	A	(1)	2	16					
			Taped voice or written notes	--	A/R	--	--	--					
			Other instruments	(3)	D	--	1	24					

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Experiment No.	Experiment Name	Inflight Date Collection Periods	Nature or Source of Data	No. of Chan.	Type	Bandwidth (HZ)	Sample per sec	Total Bits/sec. (Desired)	Requires Info. on S/C Att.	Ref.	Real Time Voice During Expt.	Notes
TO17 E0476	Meteoroid Impact and Erosion	During flight?	Erosion rate on a Vycor glass surface	--	R	--	--	--	--	Form 1138, 4/66; EIP, 11/66; References 1, 4, 11, 13 & 20	--	Reference 11 (Lockheed) calls for 20-56 days experiment duration. EVA may be required.
TO20 E0697	Jet Shoes	30-60 minutes (individual exercises will last from 1-5 min.) for 2 days	Motion pictures	--	R	--	--	--	--	Form 1138, 8/66; EIP, 11/66; References 1, 5, 11, 13 & 20	X	
TO21 E0672	Meteoroid Velocity	During the entire mission	Taped voice and written notes	--	A/R	--	--	--	7 feet of 16 mm film; bits?	Yes	Form 1138, 4/66; EIP, 11/66; References 1, 5, 11, 13 & 20	
TO22 E0583	Heat Pipe	~ 2 hours	Velocity radiant flux of the par- ticles trig- gering the velocity detector.	(5)	D	--	(1)	40	1.0 x 10 ⁹ bits; ? feet of ? film	Yes	Form 1138, 4/66; EIP, 11/66; References 1, 5, 11, 13 & 20	X
TO23 E0593	Surface Absorbed Materials	Shortly after entering orbit. one hour	Still Pictures	--	R	--	--	--	--	Form 1138, 7/66; DSP, 9/66; Reference 20	--	

APPENDIX B – AAP EXPERIMENT DATA SUMMARY (CASE I)

MARCH 20 1967

AAP - 1

AAP - 2

NOTE: S/S MEANS SAMPLES/SECOND

APPENDIX B – AAP EXPERIMENT DATA SUMMARY (CASE I)

AAP - 3

MARCH 20 1967

ANALOG

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NOTE: S/S MEANS SAMPLES/S

JULY 7, 1967

AAP- 1A

APPENDIX C - AAP EXPERIMENT DATA SUMMARY (CASE II)

EXPT. NO.	EXPERIMENT NAME	LOCATION EXPT. PERFORMED				BI-LEVEL CHANNELS				DIGITAL CHANNELS				ANALOG CHANNELS				TOTAL ELECTRICAL DATA FROM EXPT.				DATA ON FILM				SUMMARY			
		CSM (LM & SS)	OWS	AM	MDA	LM/ATM	IU	EXT. IN SPACE	0-1 S/S	2-10 S/S	11-50 S/S	51-100 S/S	101-200 S/S	0-1 S/S	2-10 S/S	11-50 S/S	51-100 S/S	101-200 S/S	0-1 S/S	2-10 S/S	11-50 S/S	51-100 S/S	101-200 S/S	MED. BAND	WIDE BAND				
D017	CARBON DIOXIDE REMOVAL	X																											
M401	MAPPING & SURVEY SYSTEM	X																											
S005	SYNOPTIC TERRAIN PHOTOGRAPHY	X																											
S006	SYNOPTIC WEATHER PHOTOGRAPHY	X																											
S009	NUCLEAR EMULSION	X																											
S015	ZERO "G" SINGLE HUMAN CELL	X																											
S016	TRAPPED PARTICLES ASYMMETRY	X																											
S017	X-RAY ASTRONOMY	X																											
S018	MICROMeteoroid COLLECTION	X																											
S019	UV STELLAR ASTRONOMY	X																											
S020	UV/X-RAY SOLAR PHOTOGRAPHY	X																											
S063	UV AIRGLOW HORIZON PHOTOGRAPHY	X																											
S065	MULTI-BAND TERRAIN PHOTOGRAPHY	X																											
T002	MANUAL NAVIGATION SIGHTINGS	X																											
T003	IN-FLIGHT NEPHELOMETER	X																											
T004	FROG OTOLITH FUNCTION	X																											
	SUB TOTAL	15	1																										

- NOTES: 1. IT IS ASSUMED THAT MOST OF THE EXPERIMENTS WILL BE PERFORMED IN CSM.
 2. S/S MEANS SAMPLES/SECONDS.
 3. THE CIRCLED NUMBERS ARE S/S AS SHOWN IN EXPERIMENT DATA ESTIMATE CHARTS.
 (APPENDIX A)

AAP -

NOTES:

1. S/S MEANS SAMPLES/SECOND.
2. THE CIRCLED NUMBERS ARE S/S AS SHOWN IN EXPERIMENT DATA ESTIMATE CHARTS.
(APPENDIX A)

July 1967

EXPT. NO.	EXPERIMENT NAME	LOCATION EXPERIMENT PERFORMED						BI-LEVEL CHANNELS			DIGITAL CHANNELS			ANALOG CHANNELS			TOTAL ELECTRICAL DATA FROM EXPT.	DATA ON FILM	
		CSM (LMASS)	PM	OWS	AM	NDA	LM/ATM	U	EXT.	0-1 S/S	2-10 S/S	11-50 S/S	51-100 S/S	101-200 S/S	0-1 S/S	2-10 S/S	11-50 S/S	51-100 S/S	101-200 S/S
M052	BONE AND MUSCLE CHANGES	x																	
M439	STAR/HORIZON AUTOMATIC TRACKING	x																	
S061	POTATO RESPIRATION	x																	
S065	MULTI-BAND TERRAIN PHOTOGRAPHY	x																	
SUB TOTAL		4															2		
TOTAL BIT RATE DESIRED: (ALL CHANNELS USED SIMULTANEOUSLY :																	16 BPS		
TOTAL AMOUNT OF DATA DESIRED FROM EXPTS. :																		$\approx 7.4 \times 10^5$ BITS	

NOTES:

1. S/S MEANS SAMPLES/SECONDS.
2. THE CIRCLED NUMBERS ARE S/S AS SHOWN IN EXPERIMENT DATA ESTIMATE CHARTS.
(CAREFULLY)

1067

APPENDIX D - AAP DATA SUMMARY ADJUSTED FOR PLANNED PCM SYSTEMS

SUMMARY															
EXPERIMENT NO.	EXPERIMENT NAME	TYPE OF CHANNEL	MODULE EXPT. PERFORMED	NO. OF CHANNELS	ON APOLLO TYPE POM SYSTEM	ANALOG MED. AND WIDE BAND CHANNELS	TOTAL BITS/SEC	NO. OF CHANNELS ON SATURN TYPE PCM MED. AND WIDE BAND CHANNELS	ANALOG MED. AND WIDE BAND CHANNELS	TOTAL BITS/SEC	REMARKS				
D017	CARBON DIOXIDE REMOVAL	A	CSN	7	1 S/50 S/100 S/300 S/	19	17	56	12 S/50 S/120 S/	10					
M011	MAPPING & SURVEY SYSTEM	A	CSN	2				(4.516)							
S009	NUCLEAR EMULSION	A	CSN	2											
S017	X-RAY ASTRONOMY	?	?	1*		160									
S019	UV STELLAR ASTRONOMY	A	?	2		1*									
S020	UV/X-RAY SOLAR PHOTOGRAPHY	A	?	2		2 * 2 MHz	16								
T002	MANUAL NAVIGATION SIGHTINGS	A	?	2		2 * 500 Hz	16								
1004	FROG OTOLITH FUNCTION	A	4	12	2 * 500 Hz	1,92									
		0	3			24									
		31-L	1			1									
TOTAL FOR AAP-1A				22	14	1	4	6,073	8,516						
AAP - 1A															
AAP-1															
S027	GALACTIC X-RAY MAPPING	A	10					25							
T022	HEAT PIPE	D						60							
TOTAL FOR AAP-1								8							
AAP-1 & 2															
D021	EXPANDABLE AIRLOCK TECHNOLOGY	A	MDA					640							
D022	EXPANDABLE STRUCTURE FOR RECOVERY	A	MDA					1,760							
M018	VECTORCARDIogram	A	A*					1	12						
M050	METABOLIC ACTIVITY	A	A*					1*	3						
M051	CARDIOVASCULAR FUNCTION ASSESSMENT	A	A*					1,240							
M053	HUMAN VESTIBULAR FUNCTION	A	B1-L					40*							
M066	SPACE SUIT EVALUATION	A	B1-L					4*	1*						
M069	S1-124 REMOVAL	A*	A					560							
M079	ZERO "G" FLAMMABILITY	A	A*					12*	120 S/5 REPRESENTS 3 MEASUREMENTS + 100 Hz						
M088	HIGH PRESSURE GAS EXPULSION	A	A					10							
M089	HEAT EXCHANGE SERVICE	A	A*					400							
T020	JET SHOE	?	ONS					28*	1*						
T021	METEOROID VELOCITY	D	MDA					4							
S069	X-RAY ASTRONOMY	A	MDA					24*	1*						
TOTAL FOR AAP-2								50							
M039	STARHORIZON AUTOMATIC TRACKING	D	CSN	1					400						
S061	POTATO RESPIRATION	B1-L	CSN	1						560					
TOTAL FOR AAP-3															
AAP-3 & 4															
M018	VECTORCARDIogram	A	ONS					1	12						
M050	METABOLIC ACTIVITY	A	A*					1*							
M051	CARDIOVASCULAR FUNCTION ASSESSMENT	A	A*					1,280							
M053	HUMAN VESTIBULAR FUNCTION	A	B1-L					40*							
S052	WHITE LIGHT CORONOGRAPH	A	A					560							
S053	UV CORONAL SPECTROGRAPH	A	B1-L					1*							
S054	X-RAY SPECTROGRAPHIC TELESCOPE	D						16,000*							
S055	UV SPECTROMETER	A	ADD					1*							
S056	X-RAY TELESCOPE	A	SI-L					4							
TOTAL FOR AAP-4								40							
AAP 3 & 4															
AAP 1 & 2															
AAP 1															
AAP 1 & 3															
AAP 1 & 4															
AAP 1 & 5															
AAP 1 & 6															
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